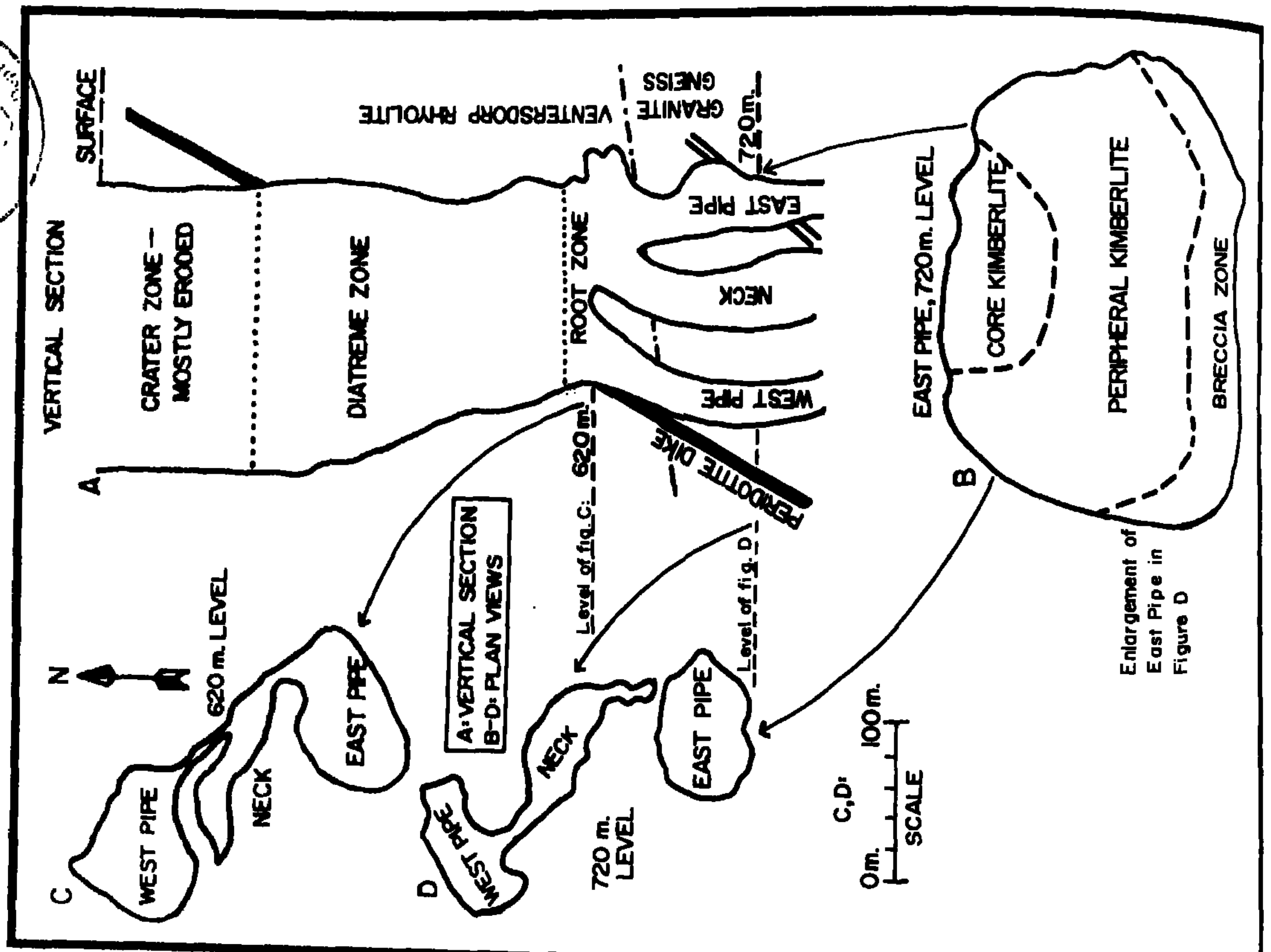

EOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION VOL. 62, NO. 43, PAGES 713-728 OCTOBER 27, 1981

Editorial

Tectonics: Instrument for International Cooperation

The search for ways in which to establish significant and mutually beneficial cooperation with similar scientific societies in other parts of the world has been a high priority of the AGU Committee on International Participation (CIP). The recent agreement with the European Geophysical Society to copublish the new journal, *Tectonics*, is a solid achievement resulting from this effort.

Using a joint publication as an instrument of truly meaningful collaboration was conceived in preliminary discussions of the CIP with the president of EGS at the annual meeting in Toronto, May 1980, and became a reality with the acceptance of a proposal from AGU by the EGS Council at its meeting in Uppsala, Sweden, in August. Although there are many subfields of geophysics in which a cooperative publishing venture might have been initiated, the decision of the AGU Council at the Baltimore meeting to create *Tectonics* presented a splendid opportunity. The creation of a new journal, a rare occurrence, offered just the chance we had envisioned in general terms in Toronto. The quantity and quality of research in tectonics in Europe are very high, so the merit of this particular proposal from the European viewpoint seemed clear. We are very glad that the EGS Council agreed.

The newly appointed editor-in-chief of *Tectonics*, John Dewey, is an ideal person around whom to build this novel effort in international cooperation. His personal background and his scientific work have given him a solid base of knowledge, experience, and contacts on both sides of the Atlantic. A North American and a European editor will work with Dewey to provide the leadership of the new journal.

The goal of the AGU in creating *Tectonics* is to offer a high-quality, prestigious outlet for the best papers in the subject. The full participation by EGS in the enterprise guarantees that at least a fair share of excellent European papers within the scope of the journal will appear in it. This should make the publication especially attractive to potential subscribers.

The most important functions of AGU are the encouragement and dissemination of good science through meetings and publications. It is appropriate that these activities have a central place in our programs of international participation. The mechanisms for joint sponsorship of meetings, for example, Chapman conferences, have long existed, though perhaps have been little used, in the international arena. This experiment in cooperation through a joint publication represents a new high in true collaboration of two geophysical societies. The new journal will succeed or fail on the basis of its quality and appeal to a substantial number of readers. The innovative nature of its sponsorship should help in the quest for excellence.

The CIP has sought ways to go beyond token expressions of friendship and goodwill in guiding AGU policy as regards other national geophysical societies. Genuine progress has been made, especially in relations with the Canadian and Mexican geophysical unions, as well as EGS. A joint publishing venture is not necessarily a model to be copied in future agreements, but it does show how imagination and a spirit of collegiality on both sides can lead to a productive result when an opportunity presents itself. Our efforts to bridge international boundaries to the benefit of all geoscientists will continue.

Carl Kisslinger
Foreign Secretary

News

Solar Mesosphere Explorer Launched

The Solar Mesosphere Explorer (SME) spacecraft was launched into orbit from Vandenburg Air Force Base on October 6, 1981, at 11:27 UT. The spacecraft is in a near-circular orbit at 540-km altitude and has the proper inclination of 97.4° to assure a 3 A.M.–3 P.M. sun-synchronous orbit. All orbit parameters appear nominal.

The SME spacecraft is designed to study the influence of changing solar ultraviolet radiation on the density of ozone in the earth's upper stratosphere and mesosphere. The satellite carries five scientific instruments, three to measure the distribution of ozone: an ultraviolet spectrometer measuring the back-scattered radiation between 255 and 310 nm, an infrared radiometer measuring thermal emission from ozone at 9.6 μm, and an infrared spectrometer measuring the 1.27 μm airglow emission resulting from ozone photolysis. In addition, the infrared radiometer measures the temperature of the atmosphere as a function of pressure and altitude by measuring the thermal emission in two portions of the 15-μm CO_2 band and the water vapor density by measuring the emission in the 6.3-μm band. A visible light spectrometer measures the density of nitrogen dioxide in the atmosphere by measuring the differential absorption of scattered sunlight at two wavelengths near 443 nm. The four atmospheric instruments will view the earth's limb once every 12 s in the plane of the orbit as the spacecraft spins at a rate of 5 rpm.

Another spectrometer is designed to monitor the solar ultraviolet flux from 120 nm to 310 nm. The SME satellite will also study the effect of charged particles entering the earth's atmosphere as a result of solar proton events to determine the relationship between the magnitude of the event and the observed decrease in ozone density.

The satellite is operated from a control center at the Laboratory for Atmospheric and Space Physics (LASP), University of Colorado, Boulder. The mission control center is staffed by undergraduate and graduate students from the University of Colorado. The SME investigator team is composed of scientists from the Laboratory for Atmospheric and Space Physics and the Department of Astro-Geophysics at the University of Colorado, the National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration Aeronomy Laboratory (NOAA), and the Jet Propulsion Laboratory (JPL). Team members include C. A. Barth (PI), G. J. Rottman, R. J. Thomas, G. H. Mount, G. M. Lawrence, G. E. Thomas, A. I. F. Stewart, C. W. Hord, and D. W. Rusch of LASP; J. London of Astro-Geophysics; J. C. Gille, P. L. Bailey, P. J. Crutzen, and R. E. Dickinson of NCAR; S. C. Lui and J. F. Noxon of NOAA; and C. B. Farmer of JPL.

The Solar Mesosphere Explorer mission is a project of the National Aeronautics and Space Administration and is managed by the Jet Propulsion Laboratory. The instruments were designed, fabricated, and tested at LASP. The spacecraft was designed and built by Ball Aerospace Systems Division in Boulder.

This news item was contributed by David W. Rusch, a research associate at the Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder.

NRC Favors Original Solar Mission

Following a review of alternatives to the International Solar Polar Mission (ISPM), a National Research Council panel concluded that the original mission with two space probes would provide net benefits 'much greater' than any of the scaled-down options. Now slated for launch no earlier than 1986, ISPM was to be the first exploration far out of the ecliptic plane in which the planets orbit the sun.

The original ISPM plans called for the European Space Agency (ESA) to build one space probe and for the National Aeronautics and Space Administration (NASA) to build the other probe, which would include X ray, extreme ultraviolet, and visible light instruments to take images of the sun. Both probes were to be launched by NASA. Budget cuts earlier this year (*Eos*, March 24, 1981, p. 123) halted the development of a U.S. spacecraft for ISPM. In June, following protests from ESA and others, Congress partially restored ISPM funding and requested a review of alternatives.

Five versions of the solar mission were reviewed by the NRC panel: the original two-probe ISPM plan, with an estimated cost to the U.S. of $410 to $416 million; an ESA probe and a modified NASA spacecraft carrying only a single imaging instrument (estimated U.S. cost: $380–$430 million); one ESA and one NASA spacecraft, both without imaging (estimated U.S. cost: $310–$330 million); two ESA spacecraft, both without imaging (estimated U.S. cost: $235–$250 million); and a single ESA spacecraft (estimated U.S. cost: $110–$130 million).

Copies of the panel's report, 'The International Solar Polar Mission, A Review and Assessment of Options,' may be obtained from the Committee on NASA Scientific and Technological Program Changes, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. Allen E. Puckett, at the Hughes Aircraft Co. in Culver City, Calif., chaired the NRC review panel.

TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

The Weekly Newspaper of Geophysics

Send double-spaced manuscripts (four copies) to *Eos*, AGU, 2000 Florida Avenue, N.W., Washington, D.C. 20009, or send them directly to one of the associate editors with a copy to the above address.

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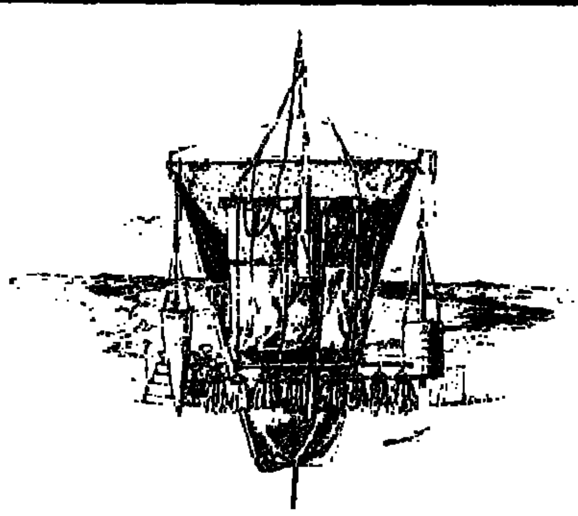
Cover. Southeastern Bering Sea shelf, showing approximated locations of the inner (~50 m depth), middle (~100 m), and shelf break (~170 m) fronts, which divide the shelf sea into distinct oceanographic domains. (See article p. 730, The Oceanography Report, this issue.)

The Oceanography Report



The Oceanography Report

The focal point for physical, chemical, geological, and biological oceanographers.

Associate Editor: Arnold L. Gordon, Lamont-Doherty Geological Observatory, Palisades, New York, 10964 (telephone 914 359-2900, ext 325)

A Synopsis of PROBES

J. J. Goering and C. P. McRoy

Introduction

The Processes and Resources of the Bering Sea Shelf (PROBES) project is a 6-year multi-institutional (University of Alaska, Florida State University, University of Washington, Brookhaven National Laboratory, Southwest Fisheries Center, Bigelow Laboratory for Ocean Sciences) interdisciplinary study designed to understand the processes that contribute to the production of enormous numbers of animals (including crabs, fish, birds, mammals) in secondary and higher trophic levels in the vast Bering Sea continental shelf. The research plan is based on the hypothesis that the broad shallow shelf leads to an oceanographic structure of a semi-permanent front-interfront system in which phytoplankton primary production is coupled to a pelagic food web over the outer shelf and to a benthic food web in the middle shelf (see cover, this issue). The project has concentrated on the processes that control the survival of the early life history stages of the Alaska pollock (*Theragra chalcogramma* Pallas) as an example of mass and energy transfer in the pelagic system. PROBES began in 1976 and is sponsored by the Division of Polar Programs, National Science Foundation.

PROBES is organized into five major components of research: (1) water circulation and mixing, (2) nutrient dynamics, (3) primary productivity and phytoplankton ecology, (4) upper trophic-level ecology, and (5) ecosystem analysis and synthesis.

The justification and need for PROBES is derived from national and international interests in science and economics. The Bering Sea is the third largest sea in the world, exceeded only by the Mediterranean and South China seas. About 45% of its area is continental shelf constituting the largest American coastal sea and containing immense quantities of renewable and nonrenewable resources. The yearly economic value of its fishery resources (~5% of the total annual world catch) is several hundred million dollars. The U.S. fishing activities have been confined largely to king and tanner crabs and salmon, while for many years the foreign fishing fleets of Japan, Korea, and the Soviet Union have extensively exploited stocks of various fin-fishes (e.g., Alaska pollack, yellow-fin sole). This sea plays a major role in supplying marine protein to many nations and also has many basins with excellent petroleum potential, and extensive petroleum exploration is in the planning process. The results of PROBES will be valuable in providing an ecological basis for managment aspects of the resources of this and other high latitude continental shelves. The growing awareness of the importance of oceanic fronts in regulating oceanic productivity and chemistry, and in concentrating food and animals at all trophic levels in food webs, is additional justification for studies such as PROBES.

We attribute the success of PROBES as a multi-disciplinary team study to the strong central hypothesis that was formulated and revised with information made available from the collective efforts of all PROBES investigators. The present hypothesis is substantially different from our initial understanding of how this shelf ecosystem functions. The results of early PROBES and the Bureau of Land Management/National Oceanic and Atmospheric Administration sponsored Alaska Outer Continental Shelf Environment Assessment Program field work revealed a very different pattern of ecosystem structure and function from that initially hypothesized. In the following sections we summarize PROBES results that support the general hypothesis that major pelagic and benthic food webs leading to large stocks of animals are separated in space and are organized in relation to the three oceanic fronts that exist in the southeastern Bering Sea.

Water Circulation and Mixing in the Southeastern Bering Sea

Three fronts separate the waters overlying the southeastern Bering Sea shelf into three distinct hydrographic domains (see cover, this issue). Each domain has distinct temperature, salinity, and stratification properties, and each has different circulation features [*Coachman et al.*, 1980]. The shelf break front is within ±50 km of the shelf break (~170 m isobath), about 500 km from shore; the middle front lies over the 80 to 100-m isobaths, 350–400 km from shore; and the inner front is centered over the 50-m isobath, 80–150 km from shore. Proceeding landward from the shelf break front the hydrographic domains are called outer, middle, and coastal.

Fronts are regions of convergence in the horizontal transport (flux) of water properties in the direction normal to the front, over the water column depth encompassed by the front. On the shelf of the Bering Sea, salt is essentially conserved in both time and space, and salinity can be used to describe the fronts. Other properties such as temperature, nutrients, and biological materials (e.g., chlorophyll) frequently depict the fronts. The fronts also border changes in vertical water column structure.

The broad shelf break front (~50 km wide) extends along the shelf edge from Unimak Island to Cape Navarin. It designates the outer boundary of a less saline shelf water converging with oceanic water. An enhanced mean salinity gradient of $((\Delta S/\Delta X) \sim 10 \times 10^{-3}\ g\ kg^{-1}\ km^{-1})$ increasing seaward and extending down from the surface over the upper two-thirds of the water column defines this front. The actual orientation of the convergence zone is not vertical but slopes from the surface landward at ~1.5 to 2 m/km. A similar enhanced horizontal gradient of mean salinity and temperature in the bottom one third to one half of the water column describes the middle front and also marks a transition in vertical water column structure (Figure 1). Landward of this front the middle domain is two-layered, while seaward the upper and lower relatively mixed layers are separated by a third layer replete with fine structure. The 15 to 20-km wide inner front is also a region of change in water column structure, from two layers in the middle domain to vertically well mixed in the coastal domain. The inner front has mean horizontal salinity gradients of $\sim 2 \times 10^{-3}\ g\ kg^{-1}\ km^{-1}$ and is also layered, the gradients being more strongly developed in the lower half of the water column. Horizontal salinity gradients are low $(\sim 1 \times 10^{-3}\ g\ kg^{-1}\ km^{-1})$ across the middle domain, while in the coastal domain gradients are an order larger $(\sim 10 \times 10^{-3}\ g\ kg^{-1}\ km^{-1})$.

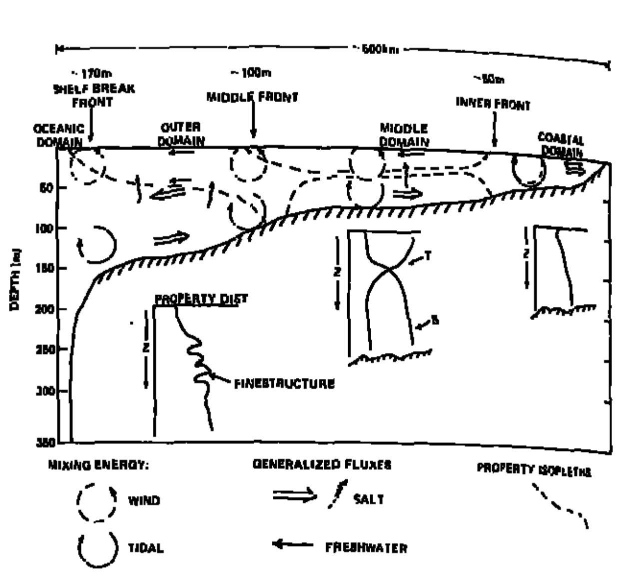


Fig. 1. A schematic diagram of the mixing energy balance in the different domains and associated water column structures. Note the correlation of the fronts with regions of greater bottom slope. Also indicated are generalized isopleth distributions and salt and freshwater fluxes [from *Coachman et al.*, 1980].

The Bering Sea shelf break front is analogous with other extensively studied mid-latitude shelf edge fronts such as those of the mid-Atlantic Bright and Nova Scotia. The inner front appears characteristic of the shelf fronts described around the British Isles, while the middle front may have counterparts in other very broad mid-latitude seas (e.g., North Sea, East China Sea).

The circulation on the southeastern Bering Sea shelf is tidally dominated. Extensive moored current meter and satellite drifter observations indicate scalar mean tidal speeds of ~20 to 25 cm/s, increasing shoreward, and most of the horizontal kinetic energy is at tidal frequencies, varying from 60% over the outer shelf to >90% in the coastal domain. Subtidal flow is weak (1–5 cm/s) and parallel to the fronts in the vicinity of the shelf break and inner fronts, while flow in the middle domain is insignificant. No evidence exists for mass or momentum exchange between this shelf and adjacent oceanic waters by eddies or current rings. Because some freshwater is continually added by land runoff while the long-term salinity field is essentially constant, on-off shelf fluxes of freshwater and salt are continuous and primarily tidally driven. A hypothesis explaining the Bering Sea shelf fronts based on the conservation of salt is discussed by *Coachman et al.* [1980].

Coachman et al. [1980] have described the mixing energy balance and the associated water column structure on the southeastern Bering Sea shelf. The inner and middle fronts are formed where vertical fluxes of water properties are enhanced by physical conditions concomitant with a basic change in water column structure. Structural change is from one to two layers at the inner front and from two to three at the middle front. The changes occur where the bottom depth exceeds the depths of balance between tidal mixing energies from the bottom up against buoyancy and wind stirring downward from above. As these energies are approximately constant over the shelf the thickness of the layers containing tidal and wind mixing energies is also about constant, thus where depth changes the structural layering of the water column also changes. These conditions, together with generalized vertical property distributions and fluxes on the southeastern Bering Sea shelf, are summarized schematically in Figure 1.

Upwelling in the middle and inner fronts is a consequence of flow convergence. In the middle front, convergence is primarily due to a landward subtidal flow beneath 30 m of ~2–3 cm/s across the outer domain. The onshore-offshore subtidal flow is variable over 1–5 day periods, and hence the intensity of convergence appears to be directly correlated to atmospheric events. This convergence results in average upwelling of $\sim 10^{-3}$ cm/s. Continuity is preserved by dispersion in the surface layer. The inner front conditions appear to be similar to those of the middle front. There is also upwelling at this front, and mass redistribution drives a small baroclinic current to the north parallel to the front which assists in maintaining continuity.

Role of Fronts in Southeastern Bering Sea Food Webs

Information relative to the effects of frontal zones on phytoplankton and zooplankton production, species composition, and community structure of high latitude shelves is sparse, but it is clear that frontal zones are often regions where biological productivity is much greater than that of the water mass on either side of the front. PROBES is studying the processes that maintain high primary productivity in shelf frontal zones as well as the mechanisms that lead to the transfer of mass and energy from primary producers to and between consumers.

In the shelf domains of the southeastern Bering Sea the patterns of phytoplankton and zooplankton growth, biomass, and species composition are organized in relation to the three fronts. Enhanced biological activity takes place preferentially within the surface layer near frontal zones; enhancement is particularly evident in the middle front where convergence of oceanic-derived materials and nutrients in lower layers leads to property upwelling. The middle front also acts as a substantial barrier, markedly reducing the landward cross-shelf transport of plankton and other particulate and dissolved materials. The focusing of materials along this front undoubtedly accounts for the notable enrichment of biological activity observed at this front [*Iverson et al.*, 1980].

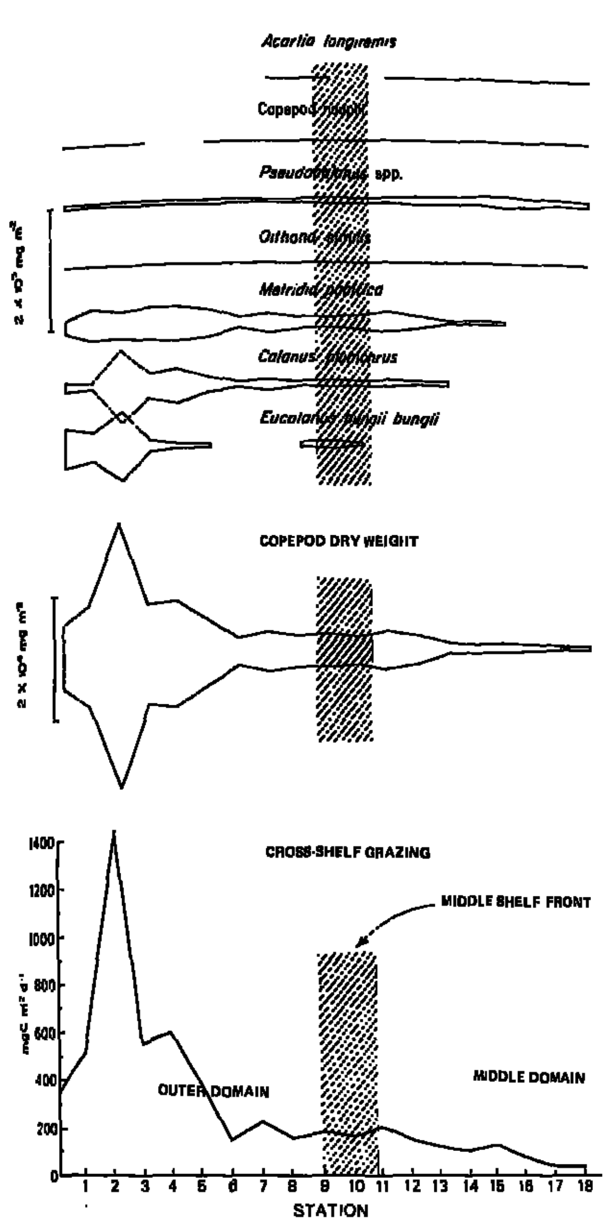


Fig. 2. Southeastern Bering Sea cross-shelf measured copepod grazing, dry weight, and species distributions (May 1979). Note position of middle front (modified from *Cooney and Coyle* [1981]).

The sequence of spring phytoplankton events and species succession differs in the middle and outer shelf domains which are separated by the middle front. Light, nutrients, grazing, and vertical turbulence all influence the growth and structure of phytoplankton communities. Turbulence, in particular, assumes an important role in controlling initiation of the spring bloom. The bloom commences first in the middle and coastal domains; these are also areas of largest bloom development.

The time course of spring phytoplankton blooms in the middle domain has been observed for several years. Increases in vertically integrated chlorophyll concentration occur after breaks in the normal pattern of storm movement (several per week) through the southeastern Bering Sea. During the past 3 years, favorable periods of water column stabilization for bloom initiation have appeared in early May. The fate of the seasonal production cycle after bloom initiation is also largely determined by the vagaries of storm events and their effects on the wind mixed layer. Meteorological events thus play an important role in regulating the primary production cycle on the southeastern Bering Sea shelf, as well as influence the intensity of convergence at the middle front and resupply of nutrients to the post bloom nutrient depleted euphotic layer.

The typical cold, northern high latitude seasonal phytoplankton successional sequence develops in the Bering Sea middle domain but not in the outer domain. In the outer domain much of the seasonal productivity (~200 g C $m^{-2}\ yr^{-2}$) is associated with *Phaeocystis pouchetii*, a non-siliceous haptophyte, whereas in the middle domain successional stages of diatoms are responsible for most of the productivity (~400 g C $m^{-2}\ yr^{-1}$). The small sized diatoms of the genera *Thalassosira* and *Chaetoceros* dominate stage I; medium sized diatoms of the genera *Chaetoceros*, *Corethron*, *Rhizosolenia*, and *Nitzschia* dominate stage II; and large long chained *Rhizosolenia alata*, which can grow under low nutrient conditions dominate stage III middle domain phytoplankton numbers. Evidence from grazing experiments suggests that most of the outer shelf diatom production is grazed by large North Pacific interzonal species of calanoid copepods and euphausiids (e.g., *Calanus cristatus*, *C. plumchrus*, *Eucalanus bungii*, *Eucalanus inermis*, and *Thysanoessa raschii*), which do not graze *Phaeocystis* [*Cooney and Coyle*, 1981]. The outer shelf domain phytoplankton community is held successionally static during spring by heavy grazing, which produces the observed low plant diversity and high dominance of *Phaeocystis*. The large herbivorous copepods and euphausiids of the outer shelf grazing community are restricted to the outer shelf domain by the physical constraints imposed by the middle front. Although small copepods (e.g., *Pseudocalanus* spp., *Oithona similis*, *Acartia longiremis*) are distributed across the whole shelf, the grazing stress on diatoms is lower in the middle domain than in the outer shelf domain.

The large outer shelf copepods have monocyclic life cycles with ontogenetic vertical migrations, in which growth and development of the copepodid stages take place in surface water, but reproduction occurs during winter in deep water off the shelf in the absence of food. Juvenile stages migrate to the surface before spring bloom initiation and begin grazing as the bloom develops. The smaller numerically dominant species of the middle shelf produce several broods per year only after food (phytoplankton) becomes abundant. Thus intense spring blooms of phytoplankton develop in the middle domain before extensive grazing begins, and grazing by these small species never harvests a large amount of the phytoplankton production. Thus underuse of phytoplankton results in significant transport of phytoplankton detritus to the seabed in the middle shelf.

The differential grazing stress imposed by the physical conditions that prevail on the southeastern Bering Sea shelf regulates the patterns of phytoplankton productivity and standing crop as well as partitions the shelf into two regions, one dominated by a pelagic food web (outer domain) and the other by a benthic food web (middle domain). The outer shelf domain is characterized by lower standing stocks of phytoplankton and by absence of a well-defined spring bloom. The large herbivorous grazers continually harvest a major portion of the primary production in the outer shelf domain, and this leads to a predominantly pelagic food web in this region of the shelf. However, in the middle shelf, substantial amounts of primary production are unharvested by the smaller copepods, and much of it is available to benthic-type food webs. The differences between domains in the levels of primary productivity and grazing result in over 3 times more phytoplankton remaining ungrazed in the middle domain than in the outer. The consequences of this cross-shelf pattern of productivity and grazing are also evident in upper trophic levels. The extensive pelagic fisheries of the Bering Sea are concentrated in the shelf break front and outer domain while the benthic related species (such as king crab and yellowfin sole) predominate in the middle shelf.

Summary

PROBES is a multi-institutional, interdisciplinary study of the marine ecosystem of the southeastern Bering Sea. The major effort of the program is to understand the processes that contribute to the large production of animals in various trophic levels. The waters over this shelf are highly structured and consist of discrete domains divided by three distinct oceanic fronts. PROBES is examining the importance of these fronts in regulating production of plants and animals and has discovered that these fronts are zones of enhanced biological activity and that the patterns of phytoplankton and zooplankton growth, biomass, and species composition are organized in relation to the fronts. The middle front, in particular, is a zone of enhanced biological activity, and it separates the middle shelf benthic dominated food web region from the outer shelf pelagic food web dominated region.

J. J. Goering and C. P. McRoy are with the Institute of Marine Science, University of Alaska, Fairbanks.

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Information Report

IUCRM Symposium

The 8th Inter-Union Commission on Radio Meteorology (IUCRM) symposium was held on May 13–20, 1981, in Miami Beach, Florida. The topic of the symposium was 'Wave Dynamics and Radio Probing of the Ocean Surface.' The symposium was also sponsored by the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), and the U.S. Navy through the Office of Naval Research (ONR). The American Meteorological Society (AMS) participated in the organization.

The purpose of the symposium was to review in depth the theoretical, experimental, and observational developments of the past few years and the presentation of new research results in basic wave dynamics, of wind-wave spectra, and interactions with oceanic structures, measurements, and analysis techniques including microwaves, HF techniques, and classical methods, 'inverse' modeling, wave prediction, and related topics such as oceanic turbulence and upper ocean layer dynamics.

The program/organizing committee consisted of Sir George Deacon, Institute of Oceanographic Sciences, Wormley, Godalming, Surrey, U.K., honorary chairman; Owen M. Phillips, Department of Earth and Planetary Sciences, The Johns Hopkins University, Baltimore, Md., chairman; Klaus Hasselmann, Max-Planck-Institute for Meteorology, Hamburg, Fed. Rep. of Germany, co-chairman; Donald E. Barrick, NOAA Environmental Research Laboratory, Boulder, Colo.; Acad. L. M. Brekhovskikh, Institute of Oceanology, Moscow, USSR; Fred W. Dobson, Bedford Institute of Oceanography, Dartmouth, Canada; Norden E. Huang, NASA Wallops Flight Center, Wallops Island, Va.; Robert B. Long, NOAA Atlantic Oceanographic & Meteorological Laboratories, Miami, Fla., Cochairman of local arrangements; M. S. Longuet-Higgens, University of Cambridge, Cambridge, U.K.; Walter H. Munk, Scripps Institution of Oceanography, La Jolla, Calif.; Duncan B. Ross, NOAA/AOML, Miami, Fla., chairman of local arrangements; Y. Toba, Geophysical Institute, Tohoku University, Sendai, Japan; G. R. Valenzuela, Naval Research Laboratory, Washington, D.C., secretary; Sture Wickerts, National Defense Research Institute, Stockholm, Sweden, chairman of IUCRM.

This IUCRM symposium, in contrast to previous ones (except for the one in Venice, Italy last year), was 'open' and attended by 181 (the estimated count was closer to 200) registered scientists and other observers; two-thirds were from the United States. The attendance included oceanographers, meteorologists, geophysicists, and about one-third radio scientists from 15 countries (i.e., Australia, Canada, Peoples Rep. of China, Denmark, France, Fed. Rep. of Germany, Ireland, Italy, Japan, Mexico, The Netherlands, Norway, United Kingdom, United States, and USSR).

The opening ceremonies of May 13 included introductory remarks by Sir George Deacon and key note addresses by Herbert Rabin (Deputy Assistant Secretary of the U.S. Navy), William Raney (Deputy Administrator for Science and Applications of NASA), and Ferris Webster (Assistant Administrator for Research and Development of NOAA).

The technical program included 6 review papers, 61 research contributions, one open workshop, and 30 poster papers. The proceedings of the symposium including comments and discussions during the presentations will be published by Plenum Press in book form with K. Hasselmann and O. M. Phillips serving as editors.

Overall, this IUCRM Symposium was a great success, helping to bring together once more oceanographers and radio scientists on the one hand and theoreticians and experimentalists on the other. One of the main outputs of this meeting was the acknowledgment that microwave remote sensing techniques from satellite, aircraft, towers, coastal piers, and in the laboratory offer a new dimension to measurements of the air-sea/water interface. In net result, these techniques are becoming widely accepted by oceanographers and geophysicists, and a number of them are planning to use these instruments in the near future. We should thank our former colleague, the late John W. Wright from the Naval Research Laboratory, for this state of affairs, since he was one of the pioneers in radio-oceanography and made important contributions to remote sensing and oceanography. As a matter of fact, his name was often quoted throughout the meeting.

The main interests in the field now are in the nonlinear processes of the surface wave field, the directional spectrum of ocean waves, and in the validation/improvement of wave prediction models. Some specific highlights of the symposium are given below. Theoretical and experimental evidence (wave tanks) was given of strong nonlinear interactions of water waves that lead to subharmonic instability, wave breaking, group splitting, crest pairing, etc. For ocean waves, the experimental evidence continues to support the concept of weakly interacting free waves with a unique dispersion relation, and nonlinear effects amount to no more than about 10%. The directional spectrum of ocean waves may be obtained from aircraft with single- and dual-frequency short-pulsed microwave radars and with ground-based HF systems. The microwave altimeter from aircraft and satellite is able to profile ocean waves with high precision, but nonlinearities of waves can introduce a bias in the mean ocean level as large as 60 cm. The SEASAT SAR yields the wavelength of ocean waves within 12 ± 7% and wave direction within 12°–15°. Longuet-Higgins presented a real breakthrough in analytical modeling of the 'overturning' fluid in plunging, breaking waves. Breaking waves contribute an unusually large amount of backscatter to microwave remote sensors. Coherent microwave radars may be the ideal instrument for investigating the elusive process of wave breaking. HF techniques are capable of determining a number of parameters of dekameter ocean waves, including near surface ocean currents. Theoretical and experimental investigations were presented on the generation of wind waves, the coupling of short waves with long gravity waves, and on the wave-induced flow in the air. The statistics of zero crossings and other parameters of wind waves were investigated in a wave tank, and they were in qualitative agreement with Longuet-Higgins' earlier predictions. NOAA's Coastal Wave Program was reviewed, together with remote sensing experiments such as ARSLOE. A future experiment to delineate the processes that lead to surface expressions of bathymetry in the wave field and radar images is being organized (SEBEX). Mesoscale turbulence processes were discussed in regard to wind measurements from radar backscatter. The symposium closed with an open workshop on Wave-Model Intercomparison, organized by K. Hasselmann. The objective was to test the numerics and physics of a number of wave prediction models that use discrete spectral, parametric, and parametric/hybrid techniques. These wave prediction models were applied to six prediction tests: limited fetch and duration, slanting fetch, windy half-plane, diagonal front, and stationary and moving hurricanes. For single prediction situations, all wave models behaved in similar fashion, after the numerics had been corrected, and the quality of the prediction depends mostly on the accuracy of the wind field used. However, for extreme situations such as hurricane conditions, a wide spread of answers resulted. For stationary hurricanes, the significant wave height varied from 10 to 25 m and for moving hurricanes the spread was 10 to

20 m. Presently, it is not possible to assess which of these predictions is correct since there is no complete data set on extreme conditions. The result is that further tests are warranted with these models, and additional data on hurricane conditions are urgently needed.

The Program/Organizing Committee is most grateful for the generous financial support of NASA, NOAA, and ONR and would like to commend the efforts of the Local Arrangements Committee composed of Duncan Ross, Bob Long, their wives and the American Meteorological Society.

G. R. Valenzuela is with the Environmental Sciences Division, Naval Research Laboratory, Washington, D.C.

News and Announcements

JGR on the South Atlantic Bight

A special issue of the *Journal of Geophysical Research* will be devoted to scientific results from studies of physical processes in the southeast U.S. continental shelf and adjacent Gulf Stream waters. Individuals who have worked in this area, especially in regard to Gulf Stream meanders and shinglas, interaction with shelf water, topographic influences, wind influences, and shelf circulation, are encouraged to submit manuscripts for this issue.

To aid in planning this issue, please inform Thomas N. Lee, School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149 (telephone: 305-350-7491) of the tentative title of your manuscript and authors by December 1, 1981. Manuscripts should be submitted in quadruplicate before April 1, 1982, to A. D. Kirwan, Jr., Editor, JGR, Department of Marine Science, University of South Florida, 140 Seventh Avenue South, St. Petersburg, Florida 33701. Standard JGR review procedures will be followed.

Adopted: A Practical Salinity Scale

The Unesco/ICES/SCOR/IAPSO Joint Panel on Oceanographic Tables and Standards has recommended the adoption of a Practical Salinity Scale, 1978, and a corresponding new International Equation of State of Seawater, 1980. A full account of the research leading to their recommendation is available in the series *Unesco Technical Papers in Marine Science.*

The parent organizations have accepted the panel's recommendations and have set January 1, 1982, as the date when the new procedures, formulae, and tables should replace those now in use.

So far as users are concerned, little is needed except the use of the new International Oceanographic Tables or equations: These, together with an explanatory introduction, will be made available by the Unesco Division of Marine Sciences as soon as possible.

All oceanographers are urged to use the new tables or equations for work reported on and after January 1, 1982. They should note in particular that the use of the new International Equation of State of Seawater, 1980, requires the use of salinity values determined on the Practical Salinity Scale, 1978. To avoid confusion, authors and editors are particularly requested to ensure that during the period of change, published values are accompanied by an indication as to which tables or equations have been used in their determination.

Oceanography Luncheon

A reminder: There is a limited number of tickets for the Oceanography Section Luncheon, scheduled for December 9, during the AGU Fall Meeting in San Francisco. Be sure to purchase your ticket early to ensure attendance. The luncheon speaker, Ferris Webster, will talk on the 'Research Outlook from NOAA.'

U.S.-Soviet Team Explores Polynya

Satellite pictures in 1973 of the frozen Weddell Sea near Antarctica revealed an unfrozen 'lake' surrounded by ice. In subsequent winters, the curiously unfrozen patch appeared, disappeared, reappeared, grew to nearly 300,000 km^2, and drifted westward before vanishing. The source and the effects of this unfrozen lake on its surroundings may remain a mystery for not much longer: A joint American-Soviet team recently began a 2-month, on-site investigation of the polynya (that's Russian for 'unfrozen water surrounded by ice').

Two explanations for the polynya's existence predominate. 'One is that a strong wind blows ice away before a significant amount can accumulate,' according to Arnold L. Gordon, *Eos* associate editor and professor of geological sciences at the Lamont-Doherty Geological Observatory. He is coordinating the expedition with the Arctic and Antarctic Research Institute in Leningrad. 'The other is that for some reason, enhanced convection is going on in this region. Basically, we think that the polynya is caused by upwelling of ocean heat rather than ice being removed by high winds.'

The surface waters surrounding Antarctica normally are frozen or almost so, Gordon explained, but at 200 m below the surface, the water's temperature is about 2°C. 'Warm water rises to mix with colder surface water, but such convection isn't strong enough to melt the Antarctic ice.' Such is the puzzle of the polynya.

More than being a quirk in the ice, the polynya may affect world climate and the distribution of nutrients in Antarctica's waters. 'Because of the heat lost through the polynya, there is a major cooling of the abyssal ocean going on, which is important from a climatic point of view,' Gordon said. 'Much of the waters below 1,000 m in the world's oceans are derived from the Antarctic.' In addition, the polynya may also affect organisms in the food chain, such as the tiny, shrimplike krill that are found in abundance in the Antarctic waters.

Satellites have not yet revealed a polynya this austral winter, but a slight decrease in ice concentration has been inferred from satellite observations near 66° South, 5° East. Scientists are hoping that this weakening of the ice cover will develop into a polynya. 'If none does appear this austral winter, we will study environmental conditions within the ice pack. Such a study has never been done before near the period of maximum extent,' Gordon said. For example, the American-Soviet research team will study the thickness of the snow cover and the structure of the ice in an attempt to determine how the ocean is giving up heat to the atmosphere. The chemistry and biology of the prospective polynya and the surrounding area also will be studied.

Of the expedition's 26 scientists aboard the 137-M Soviet icebreaker *Mikhail Somov*, 13 are from the Soviet Union. The American team includes nine Columbia University scientists and four others from Oregon State University and the U.S. Army Cold Regions Research and Engineering Laboratory in Hanover, N.H.

OTA: Shore Up Federal Ocean Programs

Although the federal ocean effort consists of about 90 programs, at a cost of $2.52 billion in fiscal 1980, there is no comprehensive plan or coordination for the development of new technologies to advance the programs, according to a report by an Office of Technology Assessment (OTA) panel. Federally supported technologies include ships, satellites for oceanography research, buoys, submersibles, and independent instrument systems. To shore up the development of ocean technology, Congressional initiatives may be necessary, concludes the Technology and Oceanography Assessment Advisory Panel.

There is no consistency, the panel charged, among agencies in their plans for future program or capital expenditures. Furthermore, some agencies plan for possible future technology needs, while others do not plan for new expenditures until new items become vital. And, some program plans include substantial contingencies and related activities, while others do not.

The 90 federal ocean programs are conducted primarily by eight agencies: the U.S. Coast Guard of the Department of Transportation, the Department of the Interior, the Environmental Protection Agency, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Science Foundation, and the U.S. Navy in the Department of Defense. Three of these agencies—the U.S. Coast Guard, NOAA, and the U.S. Navy—accounted for 80% of FY 1980 expenditures.

To rectify the problems, Congress could establish a *central office to support future ocean technology development*, according to the panel report. Specific technology development needs not being met by established offices also could be evaluated by Congress. Finally, Congress could establish an interagency ocean engineering strategy group to coordinate research.

In its report, 'Technology and Oceanography: An Assessment of Federal Technologies for Oceanography Research and Monitoring,' the panel identified issues in four main areas concerning federal activities: ocean technology development, oceanic data systems, ships, and satellite oceanography.

Key to the issue of ocean technology development is whether a larger and more centralized ocean engineering effort within one or more federal agencies would significantly improve the future development of ocean technology. Proposals for a centralized organization have long been opposed. Many researchers worry that one central agency would not give individual programs the attention they deserve and would not allow the flexibility that programs require for budgeting, engineering priorities, or for the support of smaller programs. OTA recognizes the drawbacks of a centralized organization: 'There is no way to centralize technology development adequately,' states the report summary, 'to meet the individual needs of every program and agency. Direct communications between the programs needing technology and the developers of technology is most important . . . and of utmost concern is assuring the availability of highly qualified personnel in each department or agency for critical program assessment and for focusing on promising directions in technology development.'

Can the growing need to handle and distribute increasingly large volumes of oceanic data to a variety of users be met effectively within existing agencies? 'Federal programs have not given adequate attention to the handling and distribution of oceanographic data,' the panel maintains. Two steps need to be taken so that oceanic data will serve the growing user needs. First, OTA recommends, assign agency or program responsibility for comprehensive management geared to user needs. Then, choose a federal, regional, or private data management system and update it with modern technology. 'Congress could initiate the first step by requiring that data management for all end-users be included in plans and budgets for major new programs.'

OTA warned that the capabilities of the federal oceanographic fleet will continue to degrade without new funds or more efficient arrangements that will reduce costs. To assist coordination among agencies, Congress could establish and fund an interagency ship planning council. Such a council could have the authority to specify management and planning in an effort to reduce costs.

'Satellite remote sensing could become the fastest growing segment of oceanography if certain agency plans are followed,' OTA stated; they evaluated whether the benefits of this costly technology warrant the costs. Satellite technologies could aid in the routing of ships, search and rescue operations, and gather immense amounts of data in a fraction of the time required by other methods. However, 'the extent to which satellites themselves will add new knowledge and thus justify very large costs is difficult to evaluate until more experience is obtained,' OTA claimed.

The panel report was prepared at the request of the Senate Committee on Commerce, Science, and Transportation. D. James Baker, Jr., of the University of Washington, chaired the review panel.—*BTR*

Meetings

Call for Papers

The 45th Annual Meeting of the American Society of Limnology and Oceanography will be held June 14–17, 1982, at North Carolina State University, Raleigh, N.C. At the Raleigh meeting, two special symposia are being organized: 'South Atlantic Bight Processes,' chaired by David W. Menzel and Thomas B. Curtin; and 'Biological Effects of Inorganic Turbidity in Lakes,' chaired by Samuel Mozley and John M. Miller. Daniel Kamykowski, Department of Marine Science and Engineering, is chairman of the local committee.

ASLO meetings are arranged into no more than four concurrent sessions of contributed papers during the 4-day period. Additional papers are presented as part of daily poster sessions.

The call for papers for the Raleigh meeting has been issued with deadline for receipt of abstracts being January 15, 1982. Because of the large number of abstracts that are submitted, it is the society policy only to accept abstracts from ASLO members.

ASLO currently has nearly 4,000 members. The officers are Richard Eppley, Scripps Institution of Oceanography, president; David Schindler, Freshwater Institute, vice president; Claire Schelske, University of Michigan, secretary; and Sumner Richman, Lawrence College, treasurer. Information about membership and membership application forms can be obtained from Mrs. Winifred Baumeister, Business Manager, ASLO, 1530 12th Avenue, Grafton, WI 53024.

The society publishes one journal, *Limnology and Oceanography.* The journal editor is Yvette Edmondson, University of Washington.

New Publications

Remote Sensing of Atmospheres and Oceans

A. Deepak (Ed.), Academic, New York, xiv + 841 pp., 1980, $45.00.

Reviewed by Conway B. Leovy

The second conference on Remote Sensing of Atmospheres and Oceans was convened in May 1979 at Williamsburg, Va., under the auspices of the Institute for Atmospheric Optics and Remote Sensing and the Office of Naval Research. The papers presented at the conference are reproduced in this volume. Like the first such conference, in 1976, these proceedings provide a good picture of most of the major problems in the field at the time, and, like most such state of the art research collections, it can be expected to have a fairly short useful half life. For those actively involved in either remote sensing research, or the use of the meteorological data gathered by remote sensing techniques, this volume will be of considerable value, however. On the whole, the papers are well written and most are presented in such a way that the important ideas can be readily appreciated by nonspecialists. The usefulness of the book is enhanced by inclusion of the discussion accompanying each presentation that serves the dual purpose of alerting the reader to underlying areas of concern in the research area and, in some cases, of clarifying just those points that will be obscure to many readers.

Some 25 papers are included under the broad headings of 'Recent Advances in Inversion Methods,' 'Remote Sounding of Atmospheric Parameters' (with subheadings of 'Temperature,' 'Aerosols,' 'Gaseous Constituents,' and 'Microwaves'), 'Remote Sounding of Winds,' 'Remote Sounding of Ocean Parameters,' and 'Interpretation of Recent Results From Space' (this last being something of a catchall, including results from new earth-viewing instruments as well as from other planets). It is impossible here to detail all of the papers, but perhaps a few highlights will indicate the flavor. Under the first heading, P. M. Toldalagi shows how the Kalman filter technique can be combined with the output of a general circulation model to provide a highly adaptive solution to the problem of assimilating a global set of remote sensing data. J. Susskind and A. Rosenberg and E.W. Koenig then present two interesting papers on the (1979) state of the art Tiros-N system, Susskind and Rosenberg on retrievals of a large number of soundings in the presence of variable cloud cover, and Koenig on the Tiros N HIRS/2 instrument and its performance in orbit. Three papers discuss the interpretation of optical measurements in terms of aerosol size distributions (A. Deepak, M. A. Box, and G. P. Box), volatility (P. Hamill, T. J. Swissler, M. Osborne, and M. P. McCormick), and detailed vertical structure (T. J. Pepin). A paper by S. L. Taylor, P. U. Bhartia, V. G. Kaveeshavar, K. F. Klenk, A. J. Fleig, and C. L. Mateer on ozone retrieval using backscattered ultraviolet radiance shows that reasonably accurate retrievals should be feasible down to 30 mbar or so if multiple scattering is properly accounted for.

Two important themes dealt with are the status of passive microwave sounding and the sensing of ocean surface parameters. N. C. Grody discusses retrieval of temperatures and geostrophic winds with the three-channel TIROS-N MSU (Microwave Sounding Unit), and shows the improvement that would be expected with a five-channel microwave sounder. D. H. Staelin discusses four microwave retrieval problems characterized by increasing nonlinearity, Doppler wind measurements, retrieval of water vapor profiles, retrieval of snow accumulation rate, and classification of diverse ice-covered polar terrains, while P. W. Rosenkranz and W. T. Bauman present a detailed discussion with illustrative examples of the use of the 10 pieces of information (five channels and two polarizations) of the SEASAT and Nimbus 7 Scanning Multi-Channel Microwave Radiometer (SMMR). Rosenkranz and Bauman show how accuracy and resolution can be traded off in the retrieval, over oceans, of surface temperature, wind speed, water vapor, cloud and precipitation liquid water, and water vapor scale height.

The resilient problem of retrieving sea-surface temperature is discussed in papers by M. T. Chahine, L. M. McMillan, D. S. Crosby, and J. E. DePriest, and H. E. Fleming who describe the uses of the split window technique in the infrared and of truncated normal radiance distributions to remove cloud effects. It now appears that the goal of achieving global sea-surface temperature distributions with accuracies of 1°C at resolutions of a few tens of kilometers from satellite radiances alone is within reach. A theoretical paper by P. Y. Deschamps, M. Herman, J. Lenoble, D. Tanre, and M. Viollier and an applied paper by H. R. Gordon, J. L. Mueller, and R. C. Wrigley deal with the problem of removal of atmospheric aerosol effects in visible and near infrared wavelength images in order to map distributions of marine phytoplankton. Application of the technique of Gordon et al. to images from the Nimbus 7 CZCS (Coastal Zone Color Scanner) yields very encouraging results.

Additional interesting papers deal with the design and application of a ground-based remote sensing system (D. C. Hogg, F. O. Guiraud, C. G. Little, R. G. Strauch, M. T. Decker, and E. R. Westwater), retrieval of stratospheric minor constituents from Nimbus 7 limb scanning measurements (papers by L. L. Gordley and J. M. Russell and by C. D. Rodgers), and on the thermal structure of Jupiter's atmosphere (B. J. Conrath and D. Gautier). Notably absent from the conference was W. L. Smith, and no papers deal with the important area of his recent interest, the interpretation of satellite data in terms of mesoscale phenomena.

Conway B. Leovy is with the Department of Atmospheric Sciences, University of Washington, Seattle, Washington.

Classified

Seismologist/University of Utah. Search extended: the University of Utah is expanding its geophysics program in the Department of Geology and Geophysics by adding a tenure track faculty member in seismology at the assistant to associate professor level. Applicants with backgrounds and specialties in seismic reflection, seismic imaging, and theoretical seismology will be given preference. The individual will be expected to teach undergraduate and graduate courses, and to pursue an active research program with graduate students. The department has modern teaching and research programs in geology and geophysics, and has close associations with the numerical analysis and data processing groups in computer science, electrical engineering and mathematics. The geophysics component of the department has strong research and teaching programs in seismology, electrical and electromagnetic methods, thermal properties of the earth, and potential fields. Current research in seismology includes: seismological and earthquake research utilizing a new PDP 11/70 computer with plotter and terminals; monitoring of the Intermountain seismic belt by a 55 station telemetered network utilizing a new on-line PDP 11/34 computer; major experiments in seismic refraction profiling, investigations of seismic propogation from synthetic seismograms, application of inverse theory to seismology, seismic properties of volcanic systems and allied research in tectonophysics. The closing date for applications is December 31, 1981. A Ph.D. is required for this position. Applicants should submit a vita, transcripts, a letter describing his/her research and teaching goals, and names of five persons for reference to William P. Nash, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112.

University of Utah is an equal opportunity/affirmative action employer.

Structural Geologist/University of Wyoming. The University of Wyoming, Department of Geology and Geophysics seeks applicants for a tenure track appointment in structural geology expected to be available beginning fall semester 1982 or earlier. Duties will include teaching of undergraduate and graduate courses in structural geology, supervising MS and PhD theses, and research in structural geology. Appointment at assistant professor level is preferred, but applicants requesting appointment at higher rank will be considered. Salary open. Applicants must have PhD degree and be versed in quantitative theory as well as field applications of modern structural geology and regional tectonics.

Applicants should provide, by January 1, 1982, a resume, three letters of reference, and a letter of application including a statement of current research interests and courses which the applicant feels qualified to teach. Applications should be sent to

Dr. Robert S. Houston Head
Department of Geology and Geophysics
University of Wyoming
Laramie, Wyoming 82071-3006

The University of Wyoming is an equal opportunity affirmative action employer.

Engineering Geologist Geophysicist. The Department of Geological Sciences, University of Saskatchewan, has a vacant tenurable position in engineering geology geophysics. Applicants should be qualified to teach undergraduate and graduate courses and to conduct research in engineering geology. A background in structural geology may be appropriate. Well-equipped facilities are available for research in rock mechanics, fluid flow through porous media, acoustic, and electrical properties of rocks, and permafrost. Good opportunities exist for joint research with qualifications and experience. Send applications, detailed personal resume including the names of at least three referees, and other supporting data to Dr. W.G.E. Caldwell, Head, Department of Geological Sciences, University of Saskatchewan, Saskatoon, Saskatchewan, S7N 0W0.

Please note: until November 15, 1981 consideration will be given only to applicants who are Canadians or landed immigrants, after that date all applications will be considered.

Visitor Appointments: NCAR. Visitor Appointments at the High Altitude Observatory are available for new and established Ph.D.'s for up to one year periods to carry out research in solar physics, solar-terrestrial physics, and related subjects. Applicants should provide a curriculum vitae including education, work experience, publications, the names of three scientists familiar with their work and a statement of their research plans. Applications must be received by 15 January 1982, and they should be sent to: Visitor Committee, High Altitude Observatory, National Center for Atmospheric Research (NCAR), P.O. Box 3000, Boulder, Colorado 80307. NCAR is an equal opportunity affirmative action employer.

University of Utah: Faculty Positions. The Department of Geology and Geophysics invites applications for four tenure track positions at the assistant to associate professor level:

1) *Economic Geology.* The specific area of expertise is open, however, preference will be given to candidates whose research interests are in geological, geochemical, or petrological characteristics of metallic mineral deposits.
2) *Sedimentary geology.* Applicants should have research interests in modern or ancient sedimentary basins.
3) *Seismology.* Applicants with backgrounds and specialties in seismic reflection, seismic imaging or theoretical seismology will be given preference.
4) *Potential Fields:* Geophysicist with specialty in potential theory including gravity and magnetics. (The closing date for this position is January 31, 1982)

A Ph.D. or equivalent is required. The vacancies are to be filled by September 1982; the closing date for applications for positions 1–3 is December 31, 1981. Applicants should submit a vita, transcripts, a letter describing his/her research teaching goals, and names of five persons for reference to William P. Nash, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah 84112.

The University of Utah is an equal opportunity/affirmative action employer.

Faculty Positions. *Two Faculty Positions in Geology.* Tenure-track positions in geology, assistant professorships. Ph.D. preferred or equivalent experience. Fall 1982.

Petrologist-Mineralogist. Candidate must be able to teach introductory geology, mineralogy, petrology, geochemistry, and optical mineralogy/petrography.

Invertebrate Paleontologist-Soft-Rock Geologist. Candidate must be able to teach courses in invertebrate paleontology, micropaleontology, sedimentation, and historical geology. Additional expertise in recent marine environments highly desirable.

Applicants are expected to do research in their areas of expertise, and to lead students' field trips. Strong teaching and research commitments expected. Submit applications with resume and copies of transcripts, and have three letters of recommendations sent to the Chairperson, Department of Earth & Space Sciences, Indiana University-Purdue University at Fort Wayne, Fort Wayne, Indiana 46805.

Indiana University-Purdue University is an equal opportunity/affirmative action employer.

Position in Reflection Seismology/Rice University, Houston, Texas. The Department of Geology plans to expand its geophysical program. Emphasis will be on reflection seismology. At this time applications are for the first of two open faculty positions. The successful applicant will help in the search for and selection of the second faculty member.

Your main responsibility will be to lead our department into the area of modern reflection seismology. Your main teaching and research interests should be in the acquisition and processing of reflection seismic data. You should also help in developing rigorous undergraduate and graduate curricula, which are supported by the traditional strength of the Math Sciences, Physics, and Electrical Engineering Departments at Rice. Enthusiasm to work with and undertake some joint projects with our geologists is essential.

Our plans are to acquire a computer system configured for high quality data processing. Substantial seed money for this facility is already in hand. Creative cooperation with the oil and geophysical industry in Houston, including a reasonable amount of consulting, is encouraged. Salary will be commensurate with qualifications and experience. Please send your curriculum vitae, a summary of experience in seismic processing, a statement of research interests, and names of three or more references to Dr. A. W. Bally, Chairman, Department of Geology, Rice University, P.O. Box 1892, Houston, Texas 77001. Application deadline—December 1, 1981.

Rice is an equal opportunity employer.

Stanford University. A postdoctoral or research associate appointment is available in the area of space plasma physics. Topics of study include data from electron beam experiments aboard the space shuttle and the behavior of low energy plasma in the magnetosphere. Resumes and names of three references should be sent to Professor P. M. Banks, Radio Science Laboratory, Department of Electrical Engineering, Stanford University, Stanford, CA 94305.

Stanford University is an equal opportunity employer.

Faculty Position in Watershed Hydrology. The School of Forestry and Environmental Studies at Duke University invites applications for both tenure-track and research appointments in watershed hydrology. Joint appointment with other university departments is possible.

Applicants should have background in physical and biological processes important in watershed hydrology, impact of land use on water quantity and quality, and quantitative methods including statistics, systems analysis, simulation. Requires Ph.D with one degree in a natural resource area.

Write for position announcement or submit curriculum vitae, representative publications, three references by December 15 to: **Chairman, Faculty Council, School of Forestry and Environmental Studies Box EA, Duke University, Durham, NC 27706.**

Duke University is an equal opportunity/affirmative action employer.

University of North Carolina at Charlotte/Faculty Positions in Earth Sciences. The Department of Geography and Earth Sciences offers an interdisciplinary major in Earth Sciences, which includes a geology track and a developing focus on water resources. The department is seeking to fill two tenure-track faculty positions at the Assistant Professor level to begin August, 1982:

(1) Geologist with specialties in mineralogy, petrology and possibly structural geology. Must also teach introductory geology and have a field orientation.

(2) Earth Scientist with primary interests in climatology and soils along with shared responsibility for teaching introductory Earth Science courses and possibly meteorology.

All candidates for tenure track appointments must have the Ph.D. Others with substantial doctoral coursework and experience will be considered for Lecturer appointments.

Send a letter explaining your interest in either position, along with a current vitae, to Alfred W. Stuart, Chairman, Department of Geography and Earth Sciences, UNCC Station, Charlotte, NC 28223. Phone: 704-597-2293.

Closing date for initial application is January 11, 1982.

AA/EO employer

Graduate Research Assistantships in Physical Oceanography and Meteorology. The Division of Meteorology and Physical Oceanography, School of Marine and Atmospheric Science, University of Miami, invites applications from students in science or engineering with a strong background in physics and mathematics and an interest in either the atmosphere, the ocean, or their mutual interaction. Remuneration includes a yearly stipend of $7,150 plus the cost of tuition ($4,160, first year). Successful applicants may pursue either a M.S. or Ph.D. involving work in a wide range of observational/experimental or theoretical research. For details and/or application write: Dr. Friedrich Schott, Division of Meteorology and Physical Oceanography, School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, Florida 33149.

Vincent C. Kelley and Leon T. Silver Graduate Fellowships

DEPARTMENT OF GEOLOGY
THE UNIVERSITY OF NEW MEXICO

The Department of Geology of the University of New Mexico invites applications for the Vincent C. Kelley and Leon T. Silver Graduate Fellowships. The fellowships will be awarded on the basis of the scholastic record and academic promise of graduate applicants. Each fellowship will provide for a generous living stipend of $1,000/month for 9 to 12 months, and up to $2,000/year for travel and research expenses. The Caswell Silver Foundation will pay all tuition and university fees. The awards are made on an annual basis, but may be renewed for up to three years as long as the student maintains excellent academic standing and shows evidence of significant progress in research. Preference will be given to, but is not restricted to, applicants for the Ph.D. program.

An application for admission to the UNM Graduate Program, transcripts, Graduate Record Exam results (verbal, math & geology), three letters of reference and a brief statement of research goals are required for consideration for the fellowships. Application materials may be obtained from:

Rodney C. Ewing
Chairman
Department of Geology
University of New Mexico
Albuquerque, New Mexico 87131

The deadline for applications is March 1, 1982 for the Fall semester of 1982.

University of Leeds/Isotope Geologist. Applications are invited for a post of Postdoctoral RESEARCH FELLOW in the Department of Earth Sciences for a fixed term of up to two years. The research programme of the Isotope Geology Group in the Department includes geochronology oriented particularly towards evolution of metamorphic belts, and applications of radiogenic isotope geochemistry to petrogenetic problems and the present state and past history of the earth's mantle. Equipment available includes two solid-source mass spectrometers (Micromass 30 and Isomass 54) for Sm-Nd, U-Pb, Rb-Sr and REE determinations and two MS10's for K-Ar and $^{39}Ar/^{40}Ar$ with supporting chemical facilities which are dedicated to these programs and to projects in oceanic isotope geochemistry. The successful applicant will be expected to initiate work in one or more of these fields and to collaborate in appropriate current projects. Salary within the range £6070–£10160 according to age, qualifications and experience. Informal enquiries may be made to Professor J. C. Briden. Further particulars and application forms (if desired) may be obtained from the Registrar, The University, Leeds LS2 9JT, UK, quoting reference number 49/20/HG. Closing date for applications 30 November 1981.

Director of Laboratories/Building Manager. Position requires background in university research programs or business management. Minimum of Master's degree preferred. Successful candidate will oversee maintenance of a 4-storey lab/office building; manage departmental budgets and accounting procedures; oversee technical support groups. Salary $22K–$27K. Send resume and arrange for three current letters of reference to be sent to Dr. Michel Simon, Chairman, Department of Earth & Space Sciences, SUNY Stony Brook, Stony Brook, NY 11794.

SUNY Stony Brook is an equal opportunity/affirmative action employer. AK #202 B.

Surficial Geology/Ground Water. Utah State University. Tenure track position starting spring quarter of 1982 or fall quarter of 1982. Ph.D. required. Rank and salary negotiable. Surficial geology with emphasis on geologic field studies and ground water with attention to both geologic and geohydrologic aspects. Emphasis on the arid West. Closing date November 30, 1981. USU is an affirmative action equal opportunity employer. Department of Geology (07), Utah State University, Logan, Utah 84322.

SENIOR Physical Oceanographer
$A24,951–$A33,616 pa
CSIRO Marine Laboratories
Division of Oceanography
Sydney NSW, Australia

GENERAL: CSIRO has a broad charter for research into primary and secondary industry areas. The Organization has approximately 7,400 employees—2,700 of whom are research and professional scientists—located in Divisions and Sections throughout Australia. In March 1981, the CSIRO Division of Fisheries and Oceanography was formally separated into a Division of Fisheries Research and a Division of Oceanography. These Divisions collectively form the CSIRO Marine Laboratories, and are Australia's principal marine laboratories, employing about 200 scientists and support staff. The main laboratory is in Sydney and there are smaller laboratories in Brisbane and Perth.

Depending on Parliamentary approval, the Sydney activities will be transferred to new laboratories to be constructed on a deep waterfront site in Hobart, Tasmania. The appointee must be prepared to transfer to Hobart at any time after December 1982. The Australian Government has also agreed to the acquisition by CSIRO of a modern oceanographic ship to replace the presently chartered 'Sprightly.'

The interests of the Division in physical oceanography include continental shelf dynamics, mixed layer and upwelling dynamics, air-sea interaction, ocean circulation and boundary currents, the interpretation and application of satellite data, numerical modelling and geophysical fluid dynamics.

DUTIES: The appointee will take a leading role in the initiation and conduct of research within these fields and in relation to existing or future programs. On occasions, the appointee may be expected to participate in or to lead research vessel cruises.

QUALIFICATIONS: A PhD or equivalent qualification in physical oceanography, geophysical fluid dynamics or some other relevant discipline, and several years of experience and substantial research achievement.

TENURE: Indefinite with superannuation.

APPLICATIONS: In writing, quoting reference number A2425, giving full personal particulars including details of qualifications and experience, copy of academic transcript and the names of at least two professional referees should reach:

The Chief
Division of Oceanography
CSIRO
PO Box 21
CRONULLA NSW 2230
AUSTRALIA

Deadline: November 13, 1981.

CSIRO

Scientists/Meteorologists/Engineers. Science Systems and Applications, Inc., (SSAI) has positions for programmers, analysts, scientists and engineers to engage in Scientific Modeling and Data Analysis activities in the areas of:

1. PLASMA/IONOSPHERIC PHYSICS THEORETICAL SIMULATIONS
2. ATMOSPHERIC/OCEANIC SCIENCES
3. REMOTE SENSING & RADIATIVE TRANSFER/SCATTERING STUDIES
4. SATELLITE DATA ANALYSIS
5. WEATHER/CLIMATE & SEVERE STORMS STUDIES
6. ATMOSPHERIC/FLUID DYNAMICS
7. SOLAR AND PLANETARY PHYSICS AND ASTRONOMY
8. COMPUTER IMAGE PROCESSING AND SYSTEMS DISPLAYS
9. SYSTEM SOFTWARE/HARDWARE ENGINEERING
10. NUCLEAR FUSION/FISSION
11. APPLIED MATHEMATICS.

These positions involve working with NASA/NOAA/NAVY scientists in metropolitan Washington, D.C. area.

A strong background in numerical simulations, and experience in working with large scale computers is required for entry level to senior scientist/engineer positions. SSAI provides a congenial academic environment, pays liberal fringe benefits and awards bonuses to its employees.

Please send your resume with salary history and references to: SCIENCE SYSTEMS AND APPLICATIONS INC. The Aerospace Building, 10210 Greenbelt Road, Suite 140, Seabrook, MD 20706.

Assistant Professor/Department of Geology, University of Vermont. The Geology Department at the University of Vermont is recruiting for a tenure track position at the assistant professor level to begin September 1982. Field of specialization should complement existing faculty expertise in petrology, structure and regional geology. Applications are solicited in, but not restricted to, geophysics, igneous petrology/geochronology, hydrology/Pleistocene or economic geology. The successful candidate will be expected to develop a research program involving both graduate students (M.S.) and advanced undergraduates. Applications will be accepted until December 1981.

Candidates should send resume and arrange for three letters of reference to be sent to:

Dr. John C. Drake
Acting Chairman
Department of Geology
University of Vermont
Burlington, VT 05405

The University of Vermont is an equal opportunity/affirmative action employer.

Assistant/Associate Full Research Professor. Conceive and carry out original research projects in field of physical oceanography. All areas of research will be considered, but some preference will be given to applicants interested in numerical modeling, coastal zone dynamics, physics and dynamics of fronts, mixing/dispersion, mesoscale and large scale ocean circulation or air-sea interaction. Development of own research program expected. Excellent opportunities for interacting with ongoing Gulf Stream projects, Sofar float group, and new remote sensing center. Send resume and statement of research by April 1, 1982 to: Employee Relations Officer, File# E-090006, Personnel Office, UNIVERSITY OF RHODE ISLAND, 80 Lower College Road, Kingston, RI 02881.

An affirmative action/equal opportunity employer m/f.

Assistant/Associate Professor Marine Affairs. Tenure track beginning Fall 1982. Teach graduate/undergraduate courses in marine science/technology policy, marine technology, and introductory oceanography in a successful interdisciplinary department. Scholarly research, participate in student advisement and departmental administration. PhD in a marine science and appropriate relevant experience. Send resume and 3 letters of recommendation by 2/15/82 to: Employee Relations Officer, Personnel Office-E-020005, UNIVERSITY OF RHODE ISLAND, Kingston, Rhode Island 02881.

An affirmative action/equal opportunity employer m/f.

University of California, Davis: Igneous Petrologist. The Department of Geology invites applications for a tenure-track position in the field of igneous petrology, at the Assistant Professor level, effective for the academic year 1982–1983. Preference will be given to candidates whose research demonstrates a thorough understanding of field, theoretical and experimental approaches to the science and who show promise for high caliber research on fundamental problems. The successful candidate will be expected to contribute effectively to the existing teaching program in igneous petrology at both the undergraduate and graduate levels.

Departmental facilities include a thin-section laboratory and electron microprobe, both of which are supported by full-time personnel, an experimental laboratory with high pressure piston cylinder and low pressure externally heated equipment, a scanning electron microscope, stable isotope laboratory, as well as the usual equipment (XRF, XRD, computers, etc.). The University of California at Davis is located conveniently to areas containing all types of igneous rocks.

The final date for receipt of applications is February 1, 1982. The University of California is an equal opportunity/affirmative action employer.

Interested individuals should send their resume to:

Jere H. Lipps, Chair
Department of Geology
University of California
Davis, California 95616.

Yale University/Department of Geology and Geophysics. Applications are solicited for a faculty position in solid earth geophysics to begin in the academic year 1982–83. Areas of interest to the Department include seismology, exploration geophysics, mechanical and physical properties of rocks and minerals, geomagnetism, and tectonophysics.

Yale University is an equal opportunity/affirmative action employer and encourages women and members of minority groups to compete for this position.

Curriculum vitae, publications and the names of three or more referees should be sent by 31 December 1981 to Robert B. Gordon, Chairman, Department of Geology and Geophysics, P.O. Box 6666, New Haven, CT 06511.

SERVICES

PETROLEUM DEPOSITS. If you are financing, planning, designing, exploring, drilling, or digging in connection with any form of energy, you need this complete, up-to-date book about the world's petroleum deposits. Includes production and reserves for areas. Hardcover, 6 × 9 inches, 378 pages. Table of contents, drawings, index, references, 1974. $50. Tatsch Associates, 120 Thunder Road, Sudbury, MA 01776.

STUDENT OPPORTUNITIES

Graduate Research Assistantships in Physical Oceanography. Opportunities for graduate study with Research assistantship available for students interested in M.S. or Ph.D. programs. A summer program with stipend is open to college juniors. Write: Douglas Caldwell, School of Oceanography, Oregon State University, Corvallis, OR 97331.

Graduate Teaching & Research Assistantships/University of Houston. Graduate teaching & research assistantships available to qualified persons interested in Space Physics at the University of Houston. Our experimental program features rocket & balloon-borne studies of the ionosphere & magnetosphere-ionosphere coupling. Emphasis has been on active experiments, most recent being a rocket-balloon campaign at Siple station, Antarctica in December 1980. Future work includes a study of pulsating aurora & participation in Waterhole II, an auroral quenching experiment. The theoretical program is on plasma waves in the solar wind & modeling of phenomena related to current experiments. Assistantships for first year students begin at $600/mo along with out of state tuition waivers. Graduate Chairman, Physics Dept., University of Houston Central Campus, Houston, TX 77004. EOE

Meetings

Solar-Terrestrial Physics Symposium

The Fifth International Symposium on Solar-Terrestrial Physics will be held in Ottawa, Canada, on May 17–22, 1982, the week before the 1982 COSPAR (Committee on Space Research) meeting. Deadline for abstracts for the solar-terrestrial physics meeting is December 31.

A commemoration of the anniversaries of the International Polar Year, the International Geophysical Year, and the beginning of the space era is planned. The 18 scientific sessions that highlight the meeting are divided into 4 categories: sun, interplanetary medium, magnetosphere and ionosphere, and middle atmosphere/thermosphere. Physical interpretations and theory will be emphasized; discussion of data and instrumental techniques will be discouraged.

In addition, eight tutorial lectures will address scientific problems of current interest. The symposium will conclude with five general reviews on human interactions with the solar-terrestrial environment and a public forum on long-range plans for research in solar-terrestrial physics.

Send abstracts and requests for additional information to Juan G. Roederer, chairman of the program committee, Geophysical Institute, University of Alaska, Fairbanks, AK 99701 (telephone: 907-479-7282). Only one paper per author will be accepted because of time limitation during the symposium.

The symposium is organized by the Scientific Committee on Solar-Terrestrial Physics (SCOSTEP) with the cosponsorship of COSPAR, the International Association of Geomagnetism and Aeronomy (IAGA), the International Union of Radio Science (URSI), and the International Union of Pure and Applied Physics (IUPAP).

NASA Geodynamics Conference

The Fourth Annual Conference on the NASA Geodynamics Program has been scheduled for January 26–29, 1982, at the Goddard Space Flight Center in Greenbelt, Md.

Sponsored by NASA headquarters, the conference will cover the use of space techniques to study crustal deformation, plate stability, polar motion, earth rotation, gravity and magnetic fields, and regional stress.

Abstracts of papers to be considered for presentation at the conference should be sent to Jim Murphy, Program Coordinator, NASA Headquarters, Washington, D.C. 20546, Attn: ERG-2; deadline is November 23. Abstract format is available from Murphy. The conference coordinator, Patrick Taylor, requests that all those who wish to participate in the conference notify him by December 11. Write to him at NASA/Goddard Space Flight Center, Code 922, Greenbelt, MD 20771 (telephone: 301-344-5554 or -5213).

Nominations for AGU Fellows and Awards

November 15 is the deadline for nominations from the membership for AGU Fellows and December 15 for awards for 1982. Nominations for Fellows must be made on forms available from the AGU office. Nominations for medalists and awardees require only a letter of nomination and supporting material. The Bowie Medal, Ewing Medal, Horton Medal, and Macelwane Award committees are accepting nominations for 1982 at this time.

American Geophysical Union
2000 Florida Avenue, N.W.
Washington, D.C. 20009

Scholarship Assistance for Minority Students in Earth, Space, and Marine Science For 1982-1983

The American Geophysical Union is once again pleased to participate in the American Geological Institute's Minority Scholarship Assistance Program.

Eligible Candidates are:

- Graduate or undergraduate students with good academic records
- Enrolled in, or applying to, an accredited institution to study earth, space, or marine science
- Black, American Indian, or Hispanic students who are U.S. citizens

For a flyer for your student, call or write to
Member Programs • American Geophysical Union • 2000 Florida Ave., N.W. • Washington, D.C. • 20009 • 462-6903 or 800-424-2488 outside the Washington, D.C. area

For applications, write to:
William H. Mathews III, Director of Education • American Geological Institute • Box 10031, Lamar University Station • Beaumont, Texas. • 77710

Application Deadline, February 1, 1982

GAP

Oceanography

4711 Circulation
THE GULF STREAM FRONT: A COMPARISON BETWEEN SEASAT ALTIMETER OBSERVATIONS AND THEORY
T. W. Kao (Department of Civil Engineering, The Catholic University of America, Washington, D.C. 20064) R. E. Cheney

In a recent paper by Cheney and Marsh (1981) Seasat altimeter data were used to derive quantitative information on sea surface height profiles across the Gulf Stream. In another recent paper by Kao (1980) the dynamics of the Gulf Stream front was investigated and a similarity solution was obtained. The model gives a universal shape of the sea surface height rise and the width of that anomaly across the Gulf Stream. In this paper we present a quantitative comparison between the model and six Gulf Stream altimeter profiles representing a broad range of conditions. The remarkable closeness of fit is mutually reinforcing to both the model and to the role of satellite altimetry in ocean dynamics. Comparisons of the data with the well-known theories of Stommel (1966) and Charney (1955) are also made, and implications of these comparisons are explored. (Altimeter, sea-surface height, Gulf Stream).
J. Geophys. Res., Green, Paper 1C1442

4711 Circulation
A NUMERICAL MODEL OF THE WIND-DRIVEN TRANSIENT MOTION IN BASS STRAIT
E.B. Fandry (Australian Numerical Meteorology Research Centre, P.O. Box 5089AA, Melbourne, Victoria, Australia 3001.)

The dynamical equations governing the wind-induced barotropic motion of the shallow water in the Bass Strait basin with variable bathymetry are discussed qualitatively and solved numerically with a view of explaining and describing the circulation and sea-surface elevation fields. Immediately after the onset of a steady uniform wind, fluid is accelerated in the direction of the wind, and the sea-surface elevation gradient builds up at coastal boundaries to satisfy the condition of zero normal flow. During the intermediate stages towards steady state the effects of topography, the earth's rotation and bottom friction come into play, and simple arguments based on the momentum and vorticity balances are used to describe their relative importance.

A numerical model of the hydrodynamics of the Bass Strait waters is presented and the results interpreted in terms of the above theoretical ideas. Of special significance is the dominance of the topographic effect which acts to produce barotropic currents which are much larger than those in a flat bottom basin and which flow in a direction along the depth contours. It is shown that these currents are controlled by the component of wind stress acting along the isobaths, which is balanced by the bottom friction.

The energy balance within the Strait is discussed and shown to be highly dependent on the wind stress distribution. The degree of mixing by the wind as estimated by the stratification index, H/u^3, is shown to be small.

A comparison with the very limited number of observations validates some of the more prominent features of the model results.
J. Geophys. Res., Green, Paper 1C1166

4760 Sea ice
WATER DRAG COEFFICIENT OF FIRST-YEAR SEA ICE
M.P. Langleben (Department of Physics, McGill University, 3600 University Street, Montreal, Quebec, Canada, H3A 2T8)

In May 1977, eddy flux measurements of momentum were made with a three-component ultrasonic current meter in the oceanic boundary layer under a first-year floe of fast sea ice in Barrow Strait, N.W.T. Using eddy correlation methods, values of horizontal Reynolds' stress were computed from each of twenty data runs of about one-hour duration during which the mean current was reasonably steady. A least-squares analysis in which water stress was assumed proportional to the square of the mean current yielded a value for the 1-m water drag coefficient of 1.32×10^{-3} with a standard deviation of 0.06×10^{-3}. The diameter of the floe was greater than 1 km and its mean thickness was 120 cm, with a standard deviation of 4 cm and a maximum deviation of 7 cm. (Ice drift, drag coefficient, water drag).
J. Geophys. Res., Green, Paper 1C1493

4765 Surface waves, tides, and sea level
A NOTE ON THE GENERATION OF CAPILLARY WAVES BY STEEP GRAVITY WAVES – THE EFFECT OF WIND GROWTH
G.R. Valenzuela (Environmental Sciences Division, Naval Research Laboratory, Washington, D.C. 20375)

Longuet-Higgins' (1963) theory for the generation of capillaries by a steep gravity wave is generalized to the case of wind. Wind growth enhances the steepness of the crest generated capillaries and their maximum steepness now occurs farther away from the crest. Implications to remote sensing are discussed.
J. Geophys. Res., Green, Paper 1C1512

4765 Surface waves, tides and sea level
TWO-DIMENSIONAL SURF-BEAT: LONG WAVE GENERATION BY A TIME VARYING BREAK-POINT
G. Symonds (Department of Oceanography, Dalhousie University, Halifax, Nova Scotia), D.A. Huntley and A.J. Bowen

A two dimensional model of surf zone forcing of long waves by the groupiness in the incident wave field is developed. Wave induced set-up inside a surf zone with a time dependent break-point has been parametrized using a Fourier representation of the forcing in the region defined by the minimum and maximum positions of the break-point. Free waves at the group frequency and its harmonics are radiated both seawards and shorewards of the forcing region. The wave radiated shorewards is totally reflected at the shoreline producing a standing wave shorewards of the forcing region. Seawards of the forcing region an outgoing progressive wave is present, the amplitude of which depends on the relative phase between the incoming wave group and the outgoing wave reflected from the beach. Under certain conditions the amplitude of the outgoing wave goes to zero.
J. Geophys. Res., Green, Paper 1C1343

Particles and Fields—Interplanetary Space

5370 Solar wind magnetic fields
THE STRUCTURE AND DYNAMICS OF THE HELIOSPHERIC CURRENT SHEET
B. T. Thomas (Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA 91109), E. J. Smith

An analysis is presented of the Pioneer 10 and 11 magnetic field data, with regard to the sector structure in the interplanetary magnetic field. For the 3-4 years leading up to the last solar minimum, the data are shown to be consistent with the existence of a wavy equatorial current sheet in the heliosphere. Two sectors are shown to dominate the long term field structure, and each sector is shown to adopt a Parker spiral geometry in the outflowing solar wind. This observation is consistent with the existence of a tilted current sheet which is approximately flat near the sun, but which develops a large scale wavy structure due to the solar rotation. The recurrence pattern of the sector structure suggests an inertial rotation rate of 24.1 days (with a confidence limit of approximately 0.2 day), an observation which may indicate that the source of the low-latitude solar wind is at mid-latitudes on the sun. Corotating interaction regions are shown to be capable of modifying the structure of the current sheet. In particular, it is suggested that they can sheath the current sheet by overtaking the nearest fold in its wavy structure.
J. Geophys. Res., Blue, Paper 1A1061